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Abstract

Purpose: To explore how different trajectories of emotional symptoms relate to alcohol use in adolescence. **Design:** 431 participants (majority female), aged approximately 13 years at baseline were followed over three years and reported on their emotional symptoms and alcohol use. Latent class growth analyses explored different trajectories of emotional symptoms and regression models were run to relate these trajectories to alcohol use (full standard drink and binge drinking) at 36-month follow up (age 16 years). **Findings:** While the majority of adolescents were best characterised by low-stable emotional symptoms, those with high-stable symptoms were more likely to be have consumed a full standard drink of alcohol and binge drunk when aged 16 years. **Implications:** Findings highlight the importance of prevention and early intervention, particularly targeting adolescents with elevated stable emotional symptoms who were more likely to be using alcohol at 16 years of age. **Originality:** The present study is one of the first longitudinal investigations into the use of alcohol by community adolescents with different emotional symptom trajectories.

Keywords: internalising, alcohol use, adolescence, trajectories

Trajectories of emotional symptoms in adolescence: Impact on alcohol use

Introduction

Problematic alcohol use and emotional disorders (anxiety and mood) cause significant disability and commonly co-occur (Kessler et al., 2012; Teesson, Slade, & Mills, 2009). Compared to adult populations, relatively little research has been conducted exploring the development of this comorbidity in adolescents (Boschloo et al., 2011; Hasin, Stinson, Ogburn, & Grant, 2007). Furthermore, research examining emotional symptom and alcohol use development commonly fails to explore whether developmental trajectories of these behaviours are the same for all individuals. As such, longitudinal analysis examining both within, and between-person change during adolescence is needed to advance the field. The terms 'emotional symptoms' and 'emotional disorders' are used in this study as broadband terms capturing elements of both depression and anxiety symptomatology and disorders.

There is now substantial evidence that emotional symptom trajectories differ among individuals (Nandi, Beard, & Galea, 2009) and a more nuanced approach, which takes into account these differences rather than simply representing a mean growth rate for all individuals, is needed. This recognition has led to research attempting to identify subgroups of individuals that differ in their trajectories of emotional symptoms across adolescence (Dekker et al., 2007; Rodriguez, Moss, & Audrain-McGovern, 2005; Stoolmiller, Kim, & Capaldi, 2005). Such studies typically utilise growth mixture modelling (GMM) or Latent Class Growth Analysis (LCGA). Although these studies have used different age ranges and identify different numbers of emotional symptom trajectories, four typical trajectories are consistently observed in adolescence; 1) low symptoms, 2) high symptoms, 3) moderate symptoms, and 4) an increasing trajectory (Brendgen, Wanner, Morin, & Vitaro, 2005;

Dekker et al., 2007; Wiesner & Kim, 2006). When males are examined in isolation it is typical to observe a small number of adolescents characterised by decreasing symptoms (Stoolmiller et al., 2005), while females are more likely to show increasing trajectories (Dekker et al., 2007).

Research suggests that high emotional symptoms are also linked to increased alcohol use in adolescence (Measelle, Stice, & Hogansen, 2006; Sihvola et al., 2008). For example, adolescents characterised by a high and persistent risk of experiencing an anxiety or depressive disorder have been found to be more likely to meet criteria for an alcohol use disorder (Olino, Klein, Lewinsohn, Rohde, & Seeley, 2010). Yet to date, there has been no research examining how different emotional symptom trajectories relate to alcohol use in adolescence. In addition, previous studies examining alcohol use and emotional problems have tended to focus on one aspect of alcohol use, such as alcohol initiation or binge drinking, and failed to simultaneously explore the relationship between different drinking outcomes. Epidemiological evidence has shown that developmental pathways to alcohol use disorders are created well before problematic use of alcohol starts (Clark, 2004). Therefore, longitudinal research examining alcohol use at the lower end of the spectrum is needed to explore initial relationships between emotional symptoms and alcohol use when they first begin. Longitudinal evidence exploring how individuals with different trajectories of emotional symptoms consume alcohol over a critical adolescent period is needed to further understand the development of comorbid alcohol use and mental health problems and consider individual differences.

Building on existing research on emotional symptom trajectories, the aim of the current study is to conduct an investigation of how different trajectories of emotional symptoms relate to

alcohol use (consuming a full standard drink of alcohol and binge drinking) over an important adolescent period (13-16yrs). This is the first time this has been conducted in an Australian longitudinal sample. Based on previous literature, it is expected that the emotional symptom trajectories of adolescents will be characterised by four different groups; 1) some starting at a high level and remaining high, 2) some starting at a low level and remaining low, 3) some experiencing increasing symptoms, and 4) some showing middle-range stable symptoms. In addition, given the frequent comorbidity between emotional problems and alcohol use it is expected that adolescents with higher emotional symptoms will report higher alcohol use than those with lower symptom profiles.

Method

Participants and Procedure

Data was drawn from the *Climate and Preventure* (CAP) study, a cluster randomised controlled trial (RCT) evaluating the effectiveness of a prevention program for alcohol and related harms in adolescents (for further details see Newton, Teesson, Barrett, Slade, & Conrod, 2012). Only the control group of the RCT, n = 432 from five independent (private) schools in Sydney, Australia, were used for the current study to avoid intervention effects confounding natural symptom trajectories. All Year 8 students attending participating schools in 2012 were invited to take part in the study. Only those students with parental consent (passive parental consent) and who gave active consent themselves were eligible to participate. Eligible participants completed a total of five online surveys over three years, including baseline, 6-month, 12-month, 24-month, and 36-month follow-up post-baseline. The self-report questionnaire was completed by participants in a supervised (by project staff or teacher) classroom setting. Student data were linked over time using unique identifier codes to maintain confidentiality. One student was excluded from the analysis due to missing

data on the emotional symptoms scale at each wave. The follow-up rate for the final sample (n = 431) was 85% at 6-months, 91% at 12-months, 86% at 24-months, and 78% at 36-month follow-up. Participants were 72% female (n=310), mean age 13.38 years (SD =0.44) at baseline. All aspects of the study were approved by the Human Research Ethics Committee at the University of New South Wales.

Measures

Demographic information

Participants were asked to report their age and gender.

Assessment of emotional symptoms

Emotional symptoms were measured through the five-item emotional symptoms subscale of the youth self-report Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001). Participants rated items on a Likert scale ranging from 0 (not true) to 2 (certainly true) in relation to the previous 6-months. Higher scores reflected greater emotional problems (range: 0 – 10). The emotional symptoms subscale is intended to capture internalising problems, such as anxiety and depression symptoms, and has good psychometric properties (Goodman, 2001). In the current study the internal reliability was acceptable to good across all study waves (α all > 0.72).

Assessment of alcohol use

Alcohol use at the 36-month follow-up was assessed via two drinking outcomes: whether students had 1) consumed a full standard drink of alcohol (defined as containing 10 grams of alcohol), and 2) whether they had drunk alcohol to excess / 'binged' (defined as consuming five or more standard drinks on one occasion), in the previous six months. A standard drink chart was provided to participants for reference. These measures were dichotomised as

yes/no from continuous frequency measures, with the response option 'never' coded 'no', while any of the response options; 'less than monthly', 'monthly', 'weekly', and 'daily', were coded 'yes'. Although some information was lost through this process it was warranted given the overall low prevalence of alcohol use in the young community sample. Questions were modelled on those used in the School Health and Alcohol Harm Reduction Project (SHAHRP) 'Patterns of Alcohol' index (McBride, Farringdon, Midford, Meuleners, & Phillips, 2004), commonly used in adolescent populations (Conrod, Castellanos, & Mackie, 2008; Newton, Vogl, Teesson, & Andrews, 2009; Vogl et al., 2009).

Externalising symptoms

Externalising symptoms at the 36-month follow-up were assessed through the ten-item externalising subscale of the SDQ. Participants were asked to respond to items on a three-point Likert scale ranging from 0 (not true) to 2 (certainly true) in relation to the previous six months. The internal reliability of the externalising subscale was good in the current study ($\alpha = 0.79$).

Statistical Analysis

The analysis strategy consisted of two parts:

1) Latent class growth analysis modelled the different trajectories of emotional symptoms in adolescence, and
2) Regression models were run to compare alcohol use at 36-month follow-up, with emotional symptom trajectory classes as predictors. Based on the study hypotheses, those with high emotional symptoms were compared to other adolescents.

Trajectories of emotional symptoms

A number of unconditional latent class growth models were run in Mplus 7.4 (Muthén & Muthén, 1998-2010). Missing data at each follow-up wave was accommodated through full information maximum-likelihood estimation (FIML) which estimates parameters using all available data. As descriptive plots indicated some positive skew in emotional symptom data, models were estimated using maximum likelihood with robust standard errors (MLR) (Little & Rubin, 1987) which is robust to violations of multivariate normality (Schafer & Graham, 2002). Models were run with multiple starts to ensure the robustness of the log likelihood and avoid a false maximum likelihood optima (Hipp & Bauer, 2006; Morin et al., 2011). One to seven class solutions were computed. Recommendations of Ram and Grimm (2009) were followed to select the best-fitting model, which included an inspection of the Bayesian Information Criteria (BIC), Akaike Information Criteria (AIC), Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR-LRT) and Adjusted Lo-Mendell-Rubin likelihood (Adjusted LRT). After identifying the best fitting model, individuals were assigned to their most likely class based on their posterior probability values (average latent class probabilities were all >.83).

Examining alcohol use by emotional trajectories

Multiple logistic regression models were run in SPSS-23. All regression models were run with probability weightings applied, taking into account inherent uncertainty regarding class membership in latent class modelling. Separate models were run for the following outcomes; i) consumed a full standard drink of alcohol, and ii) binge drank. Unconditional (unadjusted) models were run comparing those characterised by high-stable emotional symptoms to the other classes. A second set of models (adjusted) were run with the addition of the following covariates added in one block: gender, baseline alcohol use, and externalising symptoms. Previous literature has established a link between externalising symptoms (e.g., aggressive,

oppositional, hyperactive symptoms) and alcohol use in adolescence (Jun, Sacco, Bright, & Camlin, 2015; King, Iacono, & McGue, 2004). It has also consistently been found that females experience more emotional symptoms in adolescence compared to males (Garber, Keiley, & Martin, 2002; Ge, Natsuaki, & Conger, 2006) and that males use more alcohol (Nolen-Hoeksema, 2004). Therefore, these potential confounders where included in the adjusted models.

Results

Latent class growth model selection

A series of unconditional latent class growth models ranging from one to seven classes were estimated with; i) an intercept and linear slope (fit indices displayed in Appendix Table A1), and ii) an intercept, linear slope and quadratic slope (fit indices shown in Table 1).

Insert Table 1 here

Model Fit

Model fit indices showed that on balance the best fitting and most parsimonious model was the four-class model with an intercept, linear and quadratic growth term (AIC =7602.02, BIC = 7683.39, Entropy =.79, LMR-ALRT =50.01, p <.05, BLRT p value <.01). Quadratic growth parameters were observed in a number of models therefore, models including a linear and quadratic growth term were examined. The four-class model showed satisfactory entropy with a value of .79, indicating adequate-good separation between classes.

The fit indices for the four-class quadratic growth model are presented in Table 1. On balance, the four-class model was selected as providing the best fit to the data as well being the most parsimonious.

Trajectory classes

Figure 1 displays emotional symptom trajectories by latent class. There were 195 (45%) adolescents best characterised by low initial levels of emotional symptoms (intercept =1.21, p <.01) that remained stable and low over the three years (slope =0.21, p =.34), named the low-stable class. 17 (4%) adolescents were best characterised by a quadratic growth trajectory of initial rapid increase in emotional symptoms, that then decreased between age 15 and 16 years, named the rapid-increase class (intercept =.41, p =.46; slope = 6.57, p <.01; quadratic =-1.71, p <.01). 57 (13%) adolescents had high initial levels of emotional symptoms that remained stable (intercept =5.99, p <.01; slope =0.65 p =.15), named the high-stable class. Finally, 162 (38%) adolescents were in a class named the middle-range class, with initial middle-range emotional symptoms that remained stable (intercept =3.57, p <.01; slope = -0.09, p =.80).

Insert Figure 1 here

Alcohol use by latent class

Table 2 reports alcohol use at baseline and 36-month follow-up by latent trajectory class.

Insert Table 2 here

Full standard drink of alcohol

Logistic regression results displayed in Table 3 indicated significant differences by trajectory class in relation to a full standard drink of alcohol at 36-month follow up. Specifically, adolescents with high-stable emotional symptoms were 3.3 times (95% CI [1.5, 7.4]) more likely to report having consumed a full standard drink of alcohol, compared to adolescents in the middle-range class ($p < .01$). This remained significant when controlling for covariates (OR = 3.7, 95% CI [1.6, 8.9], $p < .01$). Adolescents with high-stable emotional symptoms were also 4.4 times more likely to have consumed a full standard drink of alcohol compared to those with a rapidly increasing trajectory (OR = 4.4, 95% CI [1.1, 16.8], $p = .03$). This remained significant when controlling for all covariates (OR = 6.3, 95% CI [1.5, 26.7], $p = .01$). There were no significant differences when comparing those in the high-stable trajectory to those in the low-stable emotional trajectory. Baseline alcohol use was the only significant covariate (OR =4.7, 95% CI [1.9, 11.9], $p < .01$).

Insert Table 3 here

Binge drinking

Table 4 displays results in relation to binge drinking. Adolescents with a high-stable emotional symptom trajectory were 2.3 times more likely to report binge drinking at 36-month follow-up, compared to adolescents with middle-range emotional symptoms (OR = 2.3, 95% CI [1.1, 4.7], $p = .03$). This finding remained significant when controlling for covariates (OR = 2.2, 95% CI [1.01, 4.8], $p < 0.05$). There were no statistically significant differences comparing those in the high class to others in either the unadjusted or adjusted models. Externalising symptoms were the only significant covariate (OR = 1.1, 95% CI [1.0 – 1.2], $p = .01$).

Insert Table 4 here

Discussion

This study is one of the first to investigate how alcohol use relates to trajectories of emotional symptoms ~~from~~ in adolescence. Longitudinal data and -sophisticated analytic methods were utilised to explore individual differences in change over time in a community sample of adolescents.

As expected, there was heterogeneity in the trajectories of emotional symptoms between 13 to 16 years, best characterised by four trajectories; 1) low-stable, 2) middle-range 3) high-stable, and 4) rapidly-increasing. In line with previous research, the majority of adolescents experienced low-stable emotional symptoms (45%) or stable middle-range symptoms (38%) over the three years. A substantial portion (13%) started with relatively high emotional symptoms that remained high, while a minority (42~~2~~%) showed a rapidly increasing trajectory of emotional symptoms, demonstrating a non-linear trend over time.

These four observed trajectories are in line with previous research that has applied growth modelling to depression symptoms in adolescence (Brendgen et al., 2005; Wiesner & Kim, 2006). The rapid-increasing trajectory observed in the current sample is also consistent with increasing trajectories observed in a previous adolescent female sample (Dekker et al., 2007). However, one study observed a decreasing trajectory among males (Stoolmiller et al., 2005), which was not observed in the current sample. The decreasing trajectory observed by Stoolmiller et al. (2005) was seen in relation to an older sample (aged 15 -24 years) of males. The lack of a decreasing trajectory in the current sample may be reflective of the younger

predominately female sample in the current study. It should be noted there was a relatively small number of individuals characterised by the rapidly increasing trajectory class (n = 17). The estimates calculated and wide confidence intervals for this class in the regression models point to imprecise prediction of alcohol use for individuals characterised by this trajectory. Therefore, replication of this trajectory and its relationship to alcohol use with a larger sample size is needed.

In relation to alcohol use at 16 years of age, those with high-stable emotional symptoms were more likely to have consumed a full standard drink of alcohol in comparison to adolescents with middle-range emotional symptoms and those with a rapidly-increasing trajectory. They were also more likely to have engaged in binge drinking when compared to those in the middle-range, but no different to those in low-stable or increasing-trajectory classes. These differences remained significant over and above the effect of gender, baseline drinking and externalising symptoms. These findings are consistent with the literature linking heightened emotional symptoms and disorders to an increased chance of using alcohol and experiencing ~~an~~ alcohol use problems (Reinke, Eddy, Dishion, & Reid, 2012) and extends these findings to ~~early~~ adolescence. Several theoretical models can be used to explain the comorbidity between emotional symptoms and alcohol use. The 'self-medication hypothesis' Khantzian (1997) for example, proposes that there is a direct causal pathway between emotional symptoms and alcohol use. That is, adolescents with emotional problems drink alcohol to treat distressing emotional symptoms and problematic alcohol use develops over time. Similarly, 'the tension reduction hypothesis' posits that people use alcohol to help to relieve symptoms of anxiety (Cappell & Greeley, 1987). However, research among adolescents has not been able to directly determine whether young people use alcohol to self-medicate or reduce tension. Another possible explanation is that a range of common factors, including biological,

environmental and psychological factors, explain the comorbidity between emotional symptoms and alcohol use, in that some individuals are more likely to develop both.

The current study has significant implications for alcohol and mental health prevention. The finding that those with the highest emotional symptoms were the most likely to be involved with alcohol by age 16 years suggests that preventative efforts should target both emotional symptoms and alcohol use during early adolescence. One example of such an approach is the online school-based *Climate Schools Combined* program, an integrated intervention to prevent both substance use and mental health problems among secondary school students, which is currently under evaluation (Teesson et al., 2014) ~~(Teesson et al., 2014)~~.This universal approach (i.e. delivered to all students regardless of risk) aims to equip students with knowledge and skills in early adolescence, before young people typically initiate alcohol use and prior to the onset of mental health symptoms. Importantly, this online intervention can be readily implemented by teachers, without prior training. Alternatively, selective interventions that target 'high-risk' adolescents, such as youth already exhibiting high emotional symptoms in early adolescence, may also be beneficial in reducing the shared risk factors for comorbid alcohol use and mental health problems in later adolescence and adulthood. Possible delivery modes for a selective intervention include school or community settings, however teacher or facilitator training would first be necessary. The fact that the next most likely drinkers were adolescents with low-stable emotional symptoms indicates that for some adolescents, factors other than emotional symptoms drive their drinking. It has been shown that adolescents with different motives for using alcohol, e.g. drinking to cope or drinking for social enhancement, show different drinking patterns (Stapinski et al., 2016). Future research could extend this work by looking at different drinking motives for adolescents with different levels of emotional symptoms and develop tailored intervention approaches accordingly.

Taken together, the present findings suggest that future prevention research may benefit from addressing an array of factors, including drinking motives and emotional symptoms, and should target both 'low-risk' and -'high-risk' students, such as those with high-stable emotional symptoms in early adolescence.

These findings reinforce the importance of early and effective prevention of alcohol use and mental health symptoms, as unrecognised emerging problems have the potential to lead to significant problems in late adolescence and early adulthood, including anxiety, mood and alcohol use disorders. These disorders are associated with significant burden of disease and pose huge social and economic challenges to society, through substantial health care costs and loss of participation in the workforce (Bloom et al., 2011; Gore et al., 2011; Hu, 2006; Whiteford et al., 2013). Additionally, early onset alcohol use and mental disorders are associated with a more difficult life course, including unemployment (Paljarvi et al., 2015) and lower adult income (Wilson, Hicks, Foster, McGue, & Iacono, 2015).

Study strengths

Key strengths of this study include the examination of within-individual and non-linear patterns of change (non-uniform change e.g. rapid during some periods and slower in others), the developmental approach taken, and longitudinal study design. The use of a general community sample means results more accurately reflect the natural developmental progression of adolescent mental health problems compared to if a clinical sample had been used. Finally, this study examined alcohol use via two separate drinking outcomes, using specific measurements that were explained to participants in standard units where appropriate. This led to a higher level of precision than has been used in previous studies.

Limitations

Conclusions drawn from the present study should be viewed in light of the following limitations. First, the fact that the present sample was predominately made up of females (72%) attending independent schools in Sydney, may limit generalizability. Sample size restrictions also meant analyses could not be conducted separately for males and females and future research with larger samples are needed to confirm that the findings are equally applicable to males and females. While beyond the scope of this paper, future research could also examine gender as a moderator of the relationship between emotional symptoms and different levels of alcohol use. Adolescents were also asked to self-report emotional symptoms and alcohol use, which can be influenced by self-report biases, such as social desirability. However, good reliability and validity of self-reported substance use has been demonstrated (Del Boca & Darkes, 2003; Ramo, Liu, & Prochaska, 2012), especially when confidentiality is assured and when students self-administer surveys online (Brener, Billy, & Grady, 2003), both of which occurred in this study.

Finally, it has been argued that the application of trajectory modelling to characterise individual differences has consistently produced four prototypical trajectory classes, despite varying age ranges of samples and observation periods: 1) a consistently low group, 2) an increasing group, 3) a decreasing group, and 4) a consistently high group (Sher, Jackson, & Steinley, 2011). While this pattern has been found in relation alcohol use trajectories there have been numerous studies of psychopathology trajectories that did not find this pattern. However, three of the typical four trajectories were observed in the current study, suggesting that the generalisation of these results should be carried out with caution and the further validation of these four classes is required in other samples to confirm the validity of the class solution found in the present study.

Conclusions

The present study is the first longitudinal investigation into the use of alcohol by community adolescents with different emotional symptom trajectories. The different trajectories of emotional symptoms are in line with previous literature and add further confirmation that emotional symptoms are heterogeneous. The novel aspect of this study was the discovery that these trajectories are related to different rates of alcohol use by age 16 years. This suggests interventions targeting both emotional problems and alcohol use may see more benefits than targeting either alone, especially among individuals with higher emotional symptoms. In addition, the relatively high proportions of adolescents with low-stable emotional symptoms using alcohol also suggests that other risk factors need to be included into prevention programs to reduce these problems in the population.

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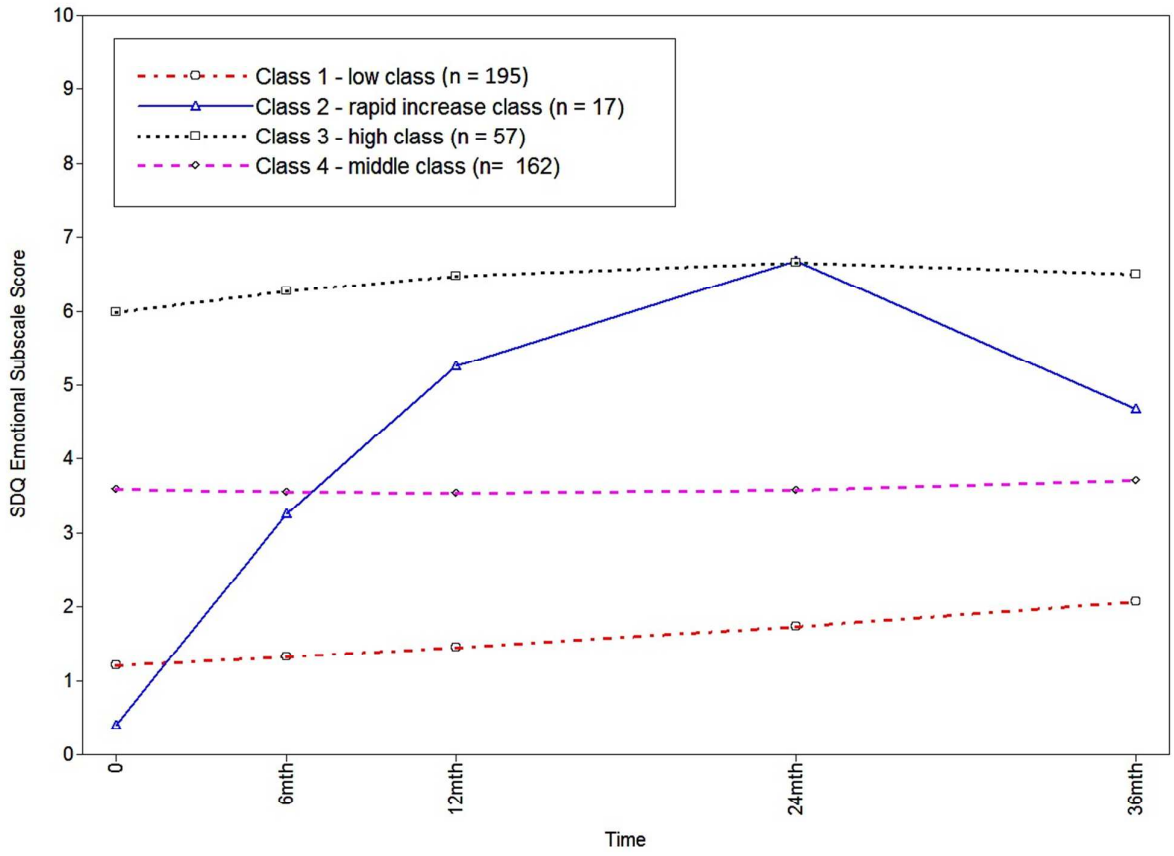
Figure

Figure 1. Four-class latent class growth analysis of trajectories of emotional symptoms



Tables

Table 1. *Fit indices for latent class growth analysis models with linear and quadratic growth term*

	Parameters	AIC	BIC	Entropy	LMR-ALRT	BLRT *p* value
1 Class	8	8235.05	8267.60	-	-	-
2 Classes	12	7773.29	7822.11	0.78	451.17**	< .01
3 Classes	16	7646.09	7711.18	0.74	129.85**	< .01
4 Classes	20	7602.02	7683.39	0.79	50.01*	< .01
5 Classes	24	7585.27	7682.92	0.75	23.77	< .01
6 Classes	28	7577.28	7691.20	0.77	15.36	< .01
7 Classes	32	7568.61	7698.80	0.77	16.02	< .01

*Note AIC= Akaike Information Criterion; BIC = Bayesian Information Criterion; LMR-LRT= Lo-Mendall-Rubin adjusted Likelihood Ratio Test; BLRT = Bootstrapped Likelihood Ratio Test. Classes beyond the 7 class model were not explored as there were less than 10 people in an individual class in the 7 class model, which is the suggested minimum for interpretability, **p < .001, * p < .05*

Tables

Table 2. *Percentage of participants who had used alcohol in the past six months at baseline and 36-month follow-up by emotional symptoms latent class membership*

	Trajectory Class			
	Class 1-Low-stable	Class 2-Rapid-Increase	Class 3-High-stable	Class 4-Middle-range
Baseline				
Had a full drink	6%	6%	12%	7%
Binged	3%	6%	5%	4%
36-mth				
Had a full drink	59%	36%	77%	48%
Binged	40%	29%	51%	32%

Tables

Table 3. *Multiple logistic regression models predicting full serve of alcohol in past 6 months at 36-moth follow-up, with latent class group comparisons*

Variable	Model 1[a]					Model 2[b]				
	β	SE	*p*	OR	95% CI	*β*	SE	*p*	OR	95% CI
Trajectory class comparisons										
High-stable vs. middle-range	1.20	0.41	<.01	3.32	1.49 - 7.40	1.32	.44	<.01	3.73	1.57 - 8.85
High-stable vs. rapid-increase	1.47	0.69	.03	4.37	1.14 - 16.80	1.84	.74	.01	6.32	1.50 - 26.67
High-stable vs. low-stable	0.74	0.40	.06	2.09	0.96 - 4.55	0.68	.44	.12	1.98	0.84 - 4.68
Gender						0.39	.29	.18	1.47	0.84 - 2.60
Baseline ever had full drink						1.55	.47	<.01	4.74	1.88 - 11.94
Externalising symptoms						<0.01	.04	.81	1.01	0.94 - 1.09

[a] *Model 1 was unadjusted and looked at the effect of latent class on alcohol use only, n = 324*

[b] *Model 2 adjusted for the covariates of gender, ever had full drink at baseline and externalising scores on the SDQ (at 36-month f/u), n = 309*

β - regression coefficient

Gender - males as reference category

Tables

Table 4. *Multiple logistic regression models predicting binge drinking (5 or more drinks) in past 6 months at 36-month follow-up, with latent class group comparisons*

Variable	Model 1[a]					Model 2[b]				
	β	SE	*p*	OR	95% CI	*β*	SE	*p*	OR	95% CI
Trajectory class comparisons										
High-stable vs. middle-range	.81	.38	.03	2.25	1.08 - 4.71	.79	.40	<.05	2.22	1.01 - 4.82
High-stable vs. rapid-increase	.72	.69	.30	2.05	0.53 - 7.87	.77	.72	.28	2.16	.53 - 8.80
High-stable vs. low-stable	.41	.36	.25	1.50	0.75 - 3.01	.26	.39	.51	1.29	.60 - 2.75
Gender						-.06	.29	.89	.94	.53 - 1.66
Baseline ever binged						.98	.80	.22	2.68	.56 - 12.70
Externalising symptoms						.09	.04	.02	1.10	1.02 - 1.18

[a] *Model 1 was unadjusted and looked at the effect of latent class on alcohol use only, n = 324*

[b] *Model 2 adjusted for the covariates of gender, ever binge drunk at baseline and externalising scores on the SDQ (at 36-month f/u), n = 309*

β - regression coefficient, Gender - males as reference category

Appendices

Table A1. *Fit indices for latent class growth analysis models with linear growth term*

	Parameters	AIC	BIC	Entropy	LMR-ALRT	BLRT *p* value
1 Class	7	8233	8262	-	-	-
2 Classes	10	7774	7815	0.78	441.37**	< .01
3 Classes	13	7646	7699	0.75	127.16**	< .01
4 Classes	16	7633	7699	0.77	17.53	.71
5 Classes	19	7621	7638	0.69	17.02	< .01
6 Classes	22	7620	7709	0.69	7.50	.16
7 Classes[a]	25	7616	7718	0.67	8.88	.11

*Note: AIC= Akaike Information Criterion; BIC = Bayesian Information Criterion; LMR-LRT= Lo-Mendall-Rubin adjusted Likelihood Ratio Test; BLRT = Bootstrapped Likelihood Ratio Test. Classes beyond the 7 class model were not explored as there were less than 10 people in an individual class in the 7 class model, which is the suggested minimum for interpretability. **p < .01*